United States Department of the Interior
Bureau of Land Management

PROGRAMMATIC BIOLOGICAL ASSESSMENT

Management of the Federal Fluid Minerals Program in Western Colorado Water Depletion Effects on the Four Endangered Big River Fishes: Bonytail (*Gila elegans*), Colorado Pikeminnow (*Ptychocheilus lucius*), Humpback Chub (*Gila cypha*), and Razorback Sucker (*Xyrauchen texanus*) in the Upper Colorado River Basin

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LIST OF ACRONYMS

Acronym or Abbreviation	Full Phrase
AF	Acre Feet
APD	Application for Permit to Drill (oil and gas)
BA	Biological Assessment
BO	Biological Opinion
Bbls	Barrels of water
BLM	Bureau of Land Management
BTC	Bonytail
CFR	Code of Federal Regulations
cfs	Cubic Feet/Second (water flow)
COA	Condition of Approval
COGCC	Colorado Oil and Gas Conservation Commission
CPM	Colorado Pikeminnow
CRVFO	Colorado River Valley Field Office
DCH	Designated Critical Habitat
DOI	Department of the Interior
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act of 1973
Gal	Gallons
GJFO	Grand Junction Field Office
HBC	Humpback Chub
HF	Hydraulic Fracturing
KFO	Kremmling Field Office
LSFO	Little Snake Field Office
MeHg	Methyl Mercury
NEPA	National Environmental Policy Act of 1969
NMFS	National Marine Fisheries Service
PBA	Programmatic Biological Assessment
PBO	Programmatic Biological Opinion
PVA	Population Viability Assessment
RBS	Razorback Sucker
RFD	reasonable foreseeable development
SSA	Species Status Assessment
SJNF	San Juan National Forest
TRFO	Tres Rios Field Office
UFO	Uncompahgre Field Office
USDI	United States Department of the Interior

USFS	United States Department of Agriculture, Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WRFO	White River Field Office
WRNF	White River National Forest

I. Introduction/Background

Management of the federal fluid mineral estate is conducted by the Department of the Interior's Bureau of Land Management (BLM), regardless of surface ownership. A necessary component to the retrieval of federal fluid minerals is the need for and use of freshwater. Water is used for various components including: pre-development seismic exploration, well drilling, completion activities including hydraulic fracturing (HF), access road dust abatement, and hydrostatic pipeline testing.

Hydraulic fracturing is the process by which a mix of materials including water is injected underground under high pressure to fracture subsurface geologic strata to release fluid minerals so that they may be mobilized for extraction.

The BLM must account for freshwater used for any of the components associated with the retrieval of federal fluid minerals that has not been previously consulted on with U. S. Fish and Wildlife Service (USFWS) with regard to its loss to the upper Colorado River Basin, and effects of that water loss on the four endangered big river fishes: Bonytail (*Gila elegans*), Colorado Pikeminnow (*Ptychocheilus lucius*), Humpback Chub (*Gila cypha*), and Razorback Sucker (*Xyrauchen texanus*). The USFWS has previously determined that any water depletions occurring within the Colorado River Basin may adversely affect these four endangered fishes and their designated critical habitat.

The BLM Colorado has been accounting for freshwater depletions associated with the retrieval of federal fluid minerals within the Upper Colorado River basin in western Colorado and effects of those depletions on the four endangered fish, via the completion of formal Section 7 consultation with the USFWS in 2008. The BLM completed a Programmatic Biological Assessment (PBA) titled: "*Programmatic Biological Assessment for BLM's Fluid Minerals Program in Western Colorado re: Water Depletions and effects on the Four Endangered Big River Fishes: Colorado Pikeminnow (Ptychocheilus lucius), Humpback Chub (Gila cypha), Bonytail (Gila elegans), and Razorback Sucker (Xyrauchen texanus)*". The USFWS responded to the BLM's PBA with a Programmatic Biological Opinion (PBO) in December 2008 (Biological Opinion number ES/GJ-6-CO-08-F-0006) affirming the BLM's approach to accounting for freshwater use and the effects of those water depletions on the four endangered fish and their critical habitat.

In the years since the completion of the 2008 consultation, conditions in the action area have changed. New technologies including broader use of HF, multi-stage HF, the use of horizontal drilling, and increased use of recycled water have come into widespread use. In addition, new data sources providing after-the-fact reported amounts of freshwater use are now available.

This Programmatic Biological Assessment will serve as the updated means by which the BLM complies with the Endangered Species Act (ESA), and addresses the effects of water depletions associated with management of the federal fluid mineral estate in western Colorado within the Colorado River Basin excluding the San Juan River basin, on four federally endangered fish: Bonytail, Colorado Pikeminnow, Humpback Chub, and Razorback Sucker. Table 1 summarizes where critical habitat exists within each of the 10 Field Offices located in western Colorado.

Table 1. Designated Critical Habitat by River in the Action Area

RIVER	SPECIES	LOCATION OF DESIGNATED CRITICAL HABITAT (DCH)
Colorado River	BTC, CPM, HBC, RBS	In the river and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 in Rifle, Colorado downstream to Lake Powell.
Dolores River	N/A	No portions of the Dolores River in Colorado are identified as Designated Critical Habitat (DCH) for any of the 4 endangered fishes. However, the Dolores River does feed the Colorado River near Dewey Bridge, UT which is DCH.
Gunnison River	CPM, RBS	In the river and its 100-year floodplain from the Uncompahgre River confluence in Delta, Colorado downstream to the confluence of the Colorado River.
Green River	BTC, CPM, HBC, RBS	The Green River downstream from its confluence with the Yampa River and its 100-year floodplain.
Yampa River	BTC, CPM, HBC, RBS	In the river and its 100-year floodplain from the Colorado Highway 394 bridge downstream to its confluence with the Green River.
White River	CPM	In the river and its 100-year floodplain from the dam on Rio Blanco Reservoir downstream to the confluence with the Green River in Utah.

BTC = Bonytail
CPM = Colorado Pikeminnow
HBC = Humpback Chub
RBS = Razorback Sucker

In accordance with Section 7(c) of the ESA, Federal land management agencies must consult with the USFWS on any action, which may affect listed species or designated critical habitat. A biological assessment must be completed if a listed species and/or critical habitat may be present in the action area as outlined in the ESA Consultation Handbook (USFWS and NMFS 1998). One of the purposes of the biological assessment is to help make the determination of whether the proposed action is “likely to adversely affect” listed species and critical habitat (USFWS and NMFS 1998).

II. Consultation History

To date, the four endangered big river fishes have undergone the following consultations regarding water depleting activities from BLM’s authorization of fluid mineral development in the upper

Colorado River Basin in western Colorado (does not include the San Juan River Basin):

- Prior to completion of the 1994 PBA, BLM completed several individual consultations on projects that depleted small amounts of water. The time and effort involved for both BLM and USFWS in completing these individual consultations led to the preparation and completion of the PBA in May 1994.

- In May 1994, the BLM Colorado prepared a PBA that addressed water-depleting activities in the Colorado River Basin. In response to the PBA, the USFWS issued a Biological Opinion (BO) on June 13, 1994 (Biological Opinion number ES/GJ-6-CO-94-F017), which determined that water depletions from the Colorado River Basin would jeopardize the continued existence of the Colorado Pikeminnow, Humpback Chub, Bonytail, and Razorback Sucker and result in the destruction or adverse modification of their critical habitat. The BO included reasonable and prudent alternatives developed by USFWS to allow the BLM to authorize projects with resultant water depletions of less than 125 acre feet (AF) per year. Projects or actions resulting in depletions of greater than 125 AF per year fall outside the PBA and require individual consultation with USFWS.

  The PBA and BO were written to remain in effect until a total depletion threshold of 1,417 AF of new depletions was reached. The threshold for historic depletions was 1,588 AF. This BO was amended March 2, 2000 and September 27, 2005.

- In January 2007, the Glenwood Springs Field Office prepared a Biological Assessment (BA) for the Resource Management Plan (RMP) for the Roan Plateau Planning Area that among other things, addressed water-depleting activities within the planning area including those associated with fluid mineral development. In response to the BA, the USFWS issued a memo dated February 7, 2007, which concurred with the BLM's determination that, among other things, water depletions from the Colorado River Basin would adversely affect the Colorado Pikeminnow, Humpback Chub, Bonytail, and Razorback Sucker and their critical habitat. Because the average annual depletion was less than 125 AF (83.6 AF/year), these depletions were addressed by the 1994 BO (amended March 2, 2000 and September 27, 2005) for small water depletions authorized by BLM in Colorado (Biological Opinion number ES/GJ-6-CO-94-F017).

- In November 2008, the BLM prepared and submitted a PBA addressing the effects of water depletions associated with the management of the federal fluid minerals program in the upper Colorado River basin in western Colorado excluding the San Juan River basin, on the four endangered big river fish. The USFWS responded in December 2008 with a Programmatic Biological Opinion (PBO) (Biological Opinion number ES/GJ-6-CO-08-F-0006) affirming the BLM's approach to accounting for freshwater use and the effects of water depletions on the four endangered fish.

- The BLM Colorado has completed RMP revisions and amendments for the Colorado River Valley Field Office (2015), Grand Junction Field Office (2015), Kremmling Field Office (2015), Little Snake Field Office (2011), Tres Rios Field Office (2015), and White River Field Office (2015). Each of these planning efforts underwent Section 7 Consultation and

each one addressed water depletions and the effects of those depletions on the four endangered fish from various activities. These documents tiered analysis of water depletion effects from fluid mineral development to the 2008 PBA/PBO effort but will be subject to this new consultation upon its completion.

- *This Programmatic Consultation covers the four endangered big river fishes, and addresses the federal Fluid Mineral Program in western Colorado as administered by the BLM Colorado. This effort is limited to analysis of effects of actions associated with the Fluid Mineral Program that result in the depletion of freshwater. This document does not attempt to address all potential impacts from fluid mineral development on the four endangered big river fishes, nor does it address program effects to other federally listed or proposed species. This consultation will be valid until factors trigger the need for a reassessment. These factors include, but are not limited to, any new and relevant information regarding any of the four listed fishes and/or their habitats; substantial impacts not previously considered; and major changes in the Fluid Mineral Program and/or its implementation in relation to water depleting activities.*

III. Species Considered and Evaluated

This PBA only addresses the four endangered big river fishes and specifically water depletions associated with the fluid mineral program as administered by the BLM in western Colorado.

Table 2. Species Considered

Common Name	Scientific Name	Federal Status
Bonytail	*Gila elegans*	Endangered – Critical Habitat
Colorado Pikeminnow	*Ptychocheilus lucius*	Endangered – Critical Habitat
Humpback Chub	*Gila cypha*	Endangered – Critical Habitat
Razorback Sucker	*Xyrauchen texanus*	Endangered – Critical Habitat

The Humpback Chub and Colorado Pikeminnow were listed as Endangered on March 11, 1967 (32 FR 4001 [USFWS 1967]). The Bonytail was added to the list of endangered species on April 23, 1980 (45 FR 27710 [USFWS 1980]), and the Razorback Sucker was listed on October 23, 1991 (56 FR 54957 [USFWS 1991]). Critical habitat for all four species was designated simultaneously on March 21, 1994 (59 FR 13374-13400 [USFWS 1994a]). The USFWS has designated critical habitat for all of these species in Colorado (Table 1).

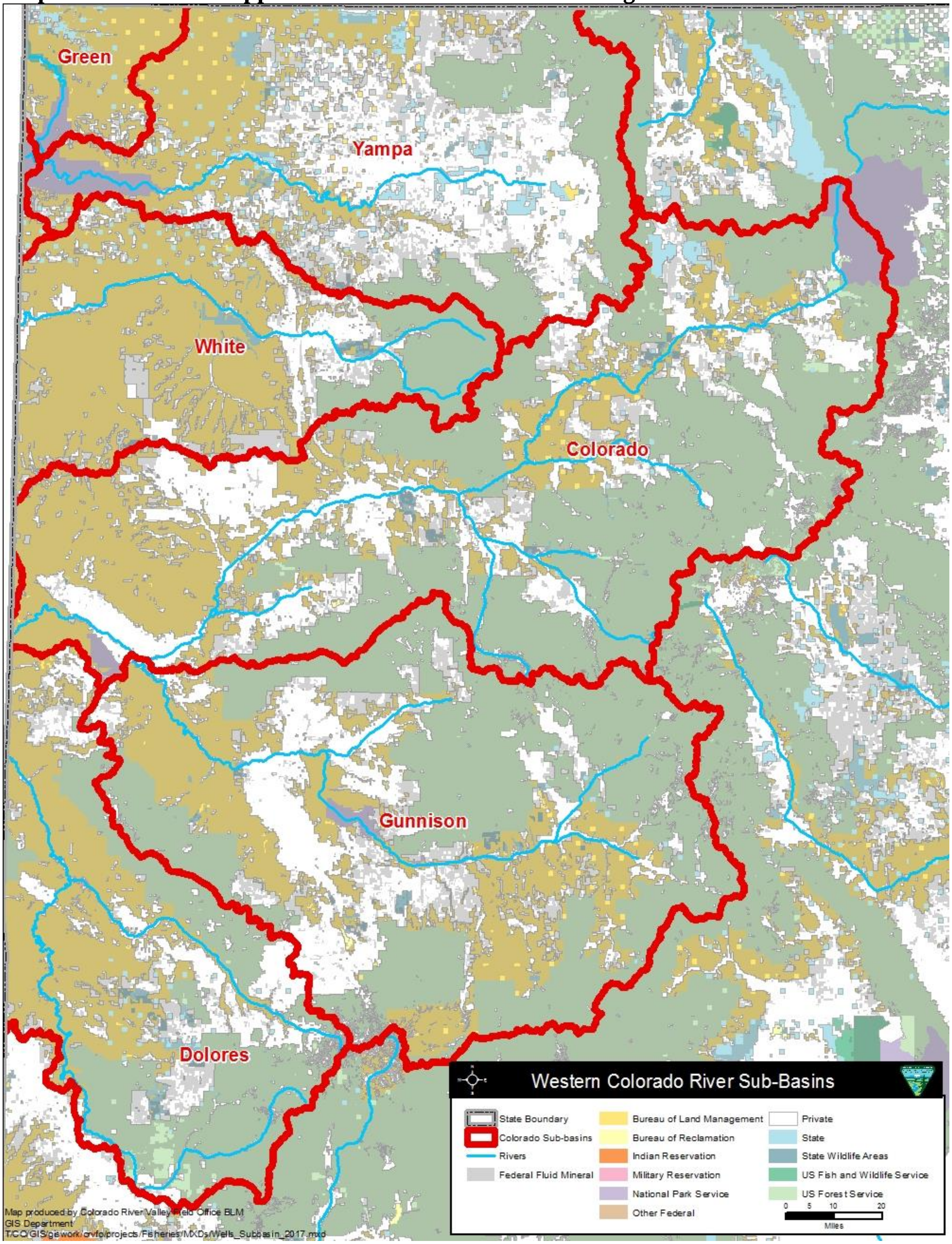
Several other federally listed taxon occur within western Colorado. However, these other listed species will not be addressed in the PBA and may be addressed in separate consultations in the event of any “May Effect” determination associated with fluid mineral development.

IV. Project Description (Proposed Action)

This PBA addresses projected freshwater use amounts and actual reported water depletion amounts associated with exploration and production of federal fluid minerals from within the Upper Colorado River Basin excluding the San Juan River basin in western Colorado (Action Area).

Within the Action Area, the BLM manages 5,178,984 acres of federal fluid mineral estate. This includes surface management by the BLM and other government agencies including the U.S. Forest Service (USFS), U.S. National Park Service, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Colorado Parks and Wildlife, and Colorado State Land Board. Remaining lands are held in private ownership (See Map 1).

Map 1 Action Area – Upper Colorado River Basin Excluding the San Juan River



The proposed action consists of ongoing and projected exploration and production of federal fluid minerals as administered by the BLM in Colorado. Projected water use amounts were first estimated during the 2008 consultation effort and were based on regional per well average estimates and the Reasonable Foreseeable Development (RFD) scenarios identified in BLM and USFS planning documents of fluid mineral activity across western Colorado for a 15 year period. The 2008 PBO calculated an overall annual threshold amount of 4,046 AF of water. Based on annual water use tracking, that threshold has yet to be exceeded. For the purposes of analysis in this PBA, we will re-estimate freshwater use amounts from all sub-basins within the Action Area.

It is very difficult to project fluid mineral development activity beyond a few years. Several highly unpredictable factors determine the amount of development that can or may occur during any given timeframe. The primary driving factor is economic conditions and specifically market prices of fluid minerals. Commodity prices are based on local, regional, and global supply and demand. Other factors that influence local activity rates include regional and national areas of development interest, current and predicted energy needs, operator plans, and availability of drill rigs, among others.

Professional judgement from the BLM petroleum engineers and private industry professionals working in the Action Area provides the best insight and information on local development trends and projected activity. The presumed life span of federal planning documents is 20 years for the BLM RMP's and USFS Forest Plans. Both agencies' planning documents rely on an RFD regarding potential activity during the life of the plan. However, RFD's are based on potential development with no constraints or encumbrances and therefore may not project activity during a specific time period. In lieu of using RFD well number projections, the analysis in this PBA relies on recent data, industry trends, and best professional opinion to estimate anticipated activity over the next 10 year period. This information represents the best available scientific information and other information available. Table 3 below shows projected annual well drilling estimates by federal land management jurisdiction.

Table 3. Ten Year Projected Well Development by River Sub-Basin

River	Number of Federal Wells
Colorado River	2580
Gunnison River	350
Dolores River	50
Yampa River	140
White River	744
Green River	7
TOTAL	**3,871**

Instead of relying on regional multipliers to estimate freshwater use per well as was done for the 2008 consultation, the BLM obtained actual reported freshwater use data on all wells (federal mineral estate as well as private mineral estate) within the Action Area from the Colorado Oil and Gas Conservation Commission (COGCC) for the years 2014-2016 (n = 859 wells). The COGCC data tracks freshwater and recycled water use associated with well completion activity (which includes water used for HF). Water use for drilling is a much smaller amount than what is used for completions and is not included in the COGCC report. Based on the best available information, the BLM will add a standard amount per well to account for freshwater used for drilling. For projection purposes, it is conservatively assumed that all water used for drilling is freshwater (i.e., no recycled water use). To confirm freshwater use estimates for drilling, the BLM is requiring operators to report all water use associated with drilling via a Condition of Approval (COA) on all Applications for Permit to Drill (APDs) backdated to January 1, 2017 for all wells BLM approves.

The BLM has taken the freshwater used per well for non-horizontal (vertical and directional) wells from the COGCC data set to obtain an average freshwater use amount for non-horizontal wells for completions. The water used for completions will be added to the well drilling amount and the dust abatement amount to calculate total projected water use for non-horizontal wells by river sub-basin based on anticipated activity levels. For horizontal wells, the BLM has taken data for all federal horizontal wells from 2012 – 2016 for drilling and completion activities to obtain an average per well estimate that will be added to the dust abatement amount to provide a total projected water use for horizontal wells by river sub-basin.

Management of federal fluid minerals includes all federal natural gas wells, oil wells, and coalbed methane natural gas wells including split estate. Water use for drilling and completions is a one-time depletion that does not accumulate from year to year (as compared to water withdrawals for agricultural or municipal water uses which deplete water annually). Water depletions for the purpose of this analysis have been defined to include:

- freshwater only
- freshwater used for access road dust abatement (calculated for the lifespan of an average well – 30 years)
- freshwater used to drill and complete wells (includes water for HF)
- freshwater associated with connected federal actions
- freshwater use associated with pre-development seismic exploration activities

Well Drilling

The amount of freshwater used for drilling of wells varies greatly depending on several factors including local geology, type of well (vertical, directional, horizontal) depth of well, length of well, time of year, and ability to use recycled water instead of freshwater. Based on discussions with operators, BLM petroleum engineers, water use data, and a supporting article http://gazette.com/the-key-ingredient-in-oil-drilling-water/article/137682 , the average freshwater amount used for drilling of non-horizontal wells is 5-7% of the total water used for completion of

wells. Projections in this PBA will use the higher 7% amount and conservatively assume that all water used for drilling of non-horizontal wells is freshwater (no recycled water use). Water use data from 2012 – 2016 on horizontal wells includes water use associated with both drilling and completion work as previously noted.

Well Completion (Including HF)
Freshwater use associated with well completions, which includes water used for HF and multi-stage HF, is the largest use of freshwater. Water use can vary greatly depending on several factors including local geology, type of well (vertical, directional, horizontal) depth/length of wells, time of year, and ability to use recycled water vs. freshwater. The COGCC requires operators to submit actual water use data broken out by freshwater and recycled water for all well completion work in Colorado. As a means of more accurately projecting freshwater use, the BLM obtained reported freshwater use amounts for completion of all wells from within the Action Area from 2014-2016 (n = 859). The COGCC data is not differentiated by well type (horizontal vs. other), so where unknown, wells for this analysis were assumed non-horizontal and the data was then broken down by river basin to obtain freshwater use estimates for each river basin based on anticipated development by well type. This assumption errs on the side of overestimating water use for non-horizontal wells as horizontal wells generally use more water. Three river basins within the Action Area had limited non-horizontal well drilling activity from 2014-2016, the Green River basin (n = 3), Gunnison River basin (n = 3), and Dolores River basin (n = 3). Instead of using these small sample sizes the Action Area average of 2.3 AF/well is used to project water use for these three river sub-basins.

For horizontal wells, BLM used water use data obtained from operators from across the state from 2012 – 2016 for drilling and completion of federal horizontal wells (n=33) plus two non-federal wells. Total freshwater use for all 35 wells was 880 AF for an average water depletion amount of 25.1 AF/well.

To avoid skewing the average depletion estimate for horizontal wells in the Action Area, two distinct areas where horizontal drilling is occurring or planned to occur were separated out from the Action Area wide freshwater use estimates since water use in these two areas has been and is anticipated to continue to be higher than elsewhere in the Action Area. Indian Valley in the WRFO and the White River basin located between Meeker, CO and Rangely, CO are projected to use an average of 51.6 AF/horizontal well. In the GJFO north of Debeque, CO in the South Shale Ridge area, average freshwater use estimates are 75.5 AF/horizontal well.

Dust Abatement
Freshwater may also be used for dust suppression of roadways used for oil and gas field access. Dust suppression is a small component of freshwater use associated with the implementation of the federal fluid mineral program. Dust abatement would be required only on roadways actively used for oil and gas access, and only during certain times of the year. The exact number of miles or acres of roads that would require dust suppression in any given year is not known. Other variables affecting the amount of water needed for dust abatement include the type of road surface and local climate conditions. Information obtained by the BLM from local operators estimates on the high end that up to 5,000 barrels of freshwater or 0.64 AF, would be used per well for dust

abatement. This amount is based on water needed to complete periodic dust abatement on well access roads during the estimated lifespan of an individual well (30 years). While the analysis period for this PBA is 10 years, we will account for all water use associated with dust abatement during the typical 30 year lifespan of a typical well. This additional amount of water will be added to the per well freshwater use estimate for all federal wells drilled within the Action Area.

Methods to reduce water depletions related to dust abatement include surface treatments such as magnesium chloride, lignin sulfate, and use of gravel. Chemical surface treatments would not be allowed in areas where they could adversely affect surface water quality or other sensitive resources.

Hydrostatic Pipeline Testing

Hydrostatic pipeline testing is a very small component of freshwater use associated with implementation of the federal fluid mineral program. Typically, newly constructed pipelines are filled with water or an inert gas such as nitrogen under pressure as a means of checking for leaks. Hydrostatic testing of pipelines is conducted sequentially in shorter segments controlled by valves. Each of the segments is about 10 percent of the total length being tested. When testing of one segment is completed, the same water is directed into the next segment for testing. Based on discussions with operators, water use associated with this activity is inconsequential other than for larger transmission pipelines. The USFWS has determined that water use of less than 0.1 AF is considered insignificant and not considered a depletion. For this PBA, the BLM will not track or add on a depletion amount per well for water use associated with hydrostatic pipeline testing. Larger transmission pipelines will be required to report freshwater use after the fact during authorizations under the BLM's Rights-of-Way program and this water will be tracked annually and reported against the overall PBA/PBO threshold amount.

Tracking and Reporting

To accurately track and report freshwater use associated with drilling and completion activities within the Action Area, the BLM will obtain and use the COGCC reported freshwater use data for completions for all federal wells annually. The BLM is also requiring operators to annually report freshwater used for drilling of all federal wells via a COA on all APDs. These two after the fact reported freshwater use amounts along with the additional 0.64 AF per well for dust abatement will then be tallied and compared to the annual threshold estimate and reported by river sub-basin to the USFWS annually at the end of the calendar year.

Natural gas development generally requires more freshwater than coalbed methane (CBM) development. While using less water for retrieval, CBM development typically results in more produced water. In Colorado, CBM produced water, like water produced from any other type of oil or gas well, is handled as waste by COGCC Rule 907, and it remains under the jurisdiction of the COGCC. However, if CBM produced water is put to a beneficial use beyond the uses allowed under Rule 907, it is subject to Colorado Department of Water Resources regulation through a permitting process and water users are subject to various controls to avoid injury to vested water rights. In general, most CBM produced water is disposed of in evaporation ponds or into Class II UIC injection wells due to the poor quality of the produced water. Where water is of sufficient quality, surface discharge for beneficial use may occur, but this would be rare within the Action

Area due to the high treatment costs and rarity of CBM wells.

Federally Connected Actions

Water use associated with connected federal actions (e.g., water use associated with the development of fee wells as actions connected to the authorization of a right-of-way to construct a natural gas pipeline, or utility or access road across federal lands) is expected to be a very small part of the overall water depleted within the Action Area.

There is uncertainty as to how many road, utility, or pipeline rights-of-way will qualify as federal connected actions, or how many would be requested or authorized each year or how many connected fee wells will be completed in association with these authorizations. Because BLM expects that the amount of water depletions associated with connected federal actions will be minimal it is not used in the derivation of water use estimates below. However, the BLM will address water use associated with connected federal actions as they arise and report that water use annually. When a future water depletion for fluid mineral development is considered to be connected to a BLM authorization, the depletion will be separately quantified, tracked, and reported in the annual report pursuant to this consultation, or will undergo separate section 7 consultation.

Seismic Activity

Seismic exploration activity is a very small component of freshwater use associated with implementation of the federal fluid mineral program. Water use associated with seismic activities is primarily associated with access road dust abatement. Seismic work generally occurs as a precursor to field development to locate desired minerals. It is impossible to foresee how much seismic activity will be authorized each year or how much water will be used in conjunction with this activity. The majority of the high potential areas have already been leased in Colorado. The BLM will tally the amount of water used for seismic activity during the NEPA process for individual proposals and add this depletion amount to the federal log at the end of the year.

ESTIMATED AVERAGE ANNUAL WATER DEPLETION BY AFFECTED RIVER SUB-BASIN

All water depletions analyzed in this PBA will occur within the Action Area. Within the Action Area, individual sub-basins will be affected to varying degrees. Federal planning documents guide fluid mineral development projection estimates for each administrative unit during the projected life of the plan – generally a 15-20 year time frame. Given the uncertainties associated with trying to project development that far out, BLM is conservatively using a shorter 10-year timeframe for well and freshwater use projection numbers and analysis. These projections are primarily in areas where established fluid mineral development is occurring or in areas identified as high potential for fluid mineral development, and areas identified in planning documents as open to leasing and development. While this approach narrows down the areas where activity is likely to occur, these projections in no way dictate exact locations where activity within each administrative unit will occur. Individual planning documents contain various constraints to drilling including No Surface Occupancy stipulations, Controlled Surface Use, and Conditions of Approval that help guide where fluid mineral development will occur within river sub-basins. The actual amount of water that will be depleted within each river sub-basin will vary from year to year and will deviate somewhat from the estimates below. The BLM does not expect, however, that the total water

depletion amounts tallied and reported will exceed the total estimated for all river basins combined.

The BLM will use the following assumptions regarding where fluid mineral development is anticipated to occur:

- Activity will continue to occur where it currently is (in developed and maturing gas fields)
- Activity will occur in areas open to leasing and identified as high potential
- New activity will generally be concentrated near existing development with the greatest well densities occurring in areas that already have wells

The data in Table 4 were derived from analysis conducted on water use data obtained from the COGCC from 2014-2016 by Colorado county within the Action Area. The COGCC data were then overlaid with river sub-basin boundaries to determine well drilling and water use amounts by river sub-basin within the Action Area. Water is reported/provided by COGCC in barrels where one barrel = 42 gallons of water and 325,851 gallons = 1 acre foot of water.

Table 4. COGCC Well Completion Water Use Data 2014-2016 (all jurisdictions)

River Sub-Basin	Sum of Freshwater (barrels)	Sum of Recycled Water (barrels)	Number of wells
Colorado River	5,429,160	40,633,228	614
Green River	6,433	0	3
Gunnison River	149,344	40,934	3
Dolores River	2,900	0	3
White River	750,304	15,389,943	220
Yampa River	415,590	0	16
Total	**6,753,731**	**56,064,105**	**859**

For non-horizontal wells, the data in Table 4 were used to conduct analysis by river sub-basin to determine water use estimates.

For horizontal wells, we used BLM data obtained from operators on reported freshwater used for 33 federal horizontal wells and 2 fee wells for drilling and completions from 2012 – 2016. Based

on this data, operators used 880 AF of freshwater to drill and complete the 35 wells resulting in an average depletion amount of 25.1 AF/horizontal well.

Colorado River

Non-Horizontal Wells

Completion Estimate: This is only using the freshwater amount data for the 614 wells.
5,429,160 bbls x 42 gal/barrel = 228,024,720 gal ÷ 325,851 gal/AF = 699.8 AF
699.8 AF ÷ 614 wells = 1.14 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater. 5,429,160 bbls + 40,633,228 bbls = 46,062,388 bbls x 42 gal/bbls = 1,934,620,296 gal ÷ 325,851 gal/AF = 5,937 AF x 7% = 416 AF ÷ 614 wells = 0.68 AF/well

Dust Abatement Estimate: 0.64 AF/well
Total = 1.14 + 0.68 + 0.64 = 2.5 AF/well

The following water use estimates cover the following jurisdictions: Colorado River Valley Field Office, White River Field Office, White River National Forest, and other Federal Mineral Estate within those offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 1,780 federal wells are likely to be drilled over the next 10 year period on all jurisdictions within the Colorado River sub-basin.

Horizontal Wells

Of the projected 1,780 federal wells, 80 are in the WRFO but within the Colorado River sub-basin. Of these 80 wells up to 10% are anticipated to be horizontal (n = 8).

Of the remaining 1,700 federal wells up to 18% could be horizontal wells (n = 306). Horizontal wells are anticipated to use the Action Area wide average amount of freshwater (25.1 AF/well).

White River Field Office wells
Drilling and Completion Estimate: 8 wells x 25.1 AF/well = 201 AF
Dust Abatement Estimate: 0.64 AF/well x 8 = 5.1 AF
Total = 206.1 AF ÷ 10 years **= 21 AF/Year**

Remaining wells
Drilling and Completion Estimate: 306 wells x 25.1 AF/well = 7,681 AF

Dust Abatement Estimate: 0.64 AF/well x 306 = 196 AF
Total = 7,877 AF ÷ 10 years **= 788 AF/Year**

Non-Horizontal Wells
Of the remaining 1,700 federal wells, approximately 82% are anticipated to be non-horizontal wells (n = 1,394)

Drilling and Completion Estimate: 1,394 wells x 2.5 AF/well = 3,485 AF
Total = 3,485 AF ÷ 10 years = **349 AF/Year**

White River Field Office wells
Of the 80 WRFO wells located in the Colorado River basin, 90% or 72 are anticipated to be non-horizontal wells

Drilling and Completion Estimate: 72 wells x 2.5 AF/well = 180 AF
Total = 180 AF ÷ 10 years = **18 AF/Year**

The following water use estimates cover the following jurisdictions: Grand Junction Field Office, Grand Mesa, Uncompahgre, and Gunnison National Forest, and other Federal Mineral Estate within those offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 800 federal wells are likely to be drilled over the next 10 year period on all jurisdictions.

Horizontal Wells
Of the projected 800 federal wells, 40% are anticipated to be horizontal wells (n= 320) Of these 320 horizontal wells, 68 are anticipated to be in the South Shale Ridge area north of DeBeque, CO where freshwater use is expected to be higher due to local geology and very limited recovery of water for reuse as has been documented.

Drilling and Completion Estimate: 252 wells x 25.1 AF/well = 6,325 AF
Dust Abatement Estimate: 0.64 AF/well x 252 = 161 AF
Total = 6,486 AF ÷ 10 years = **649 AF/Year**

South Shale Ridge Drilling and Completion Estimate: 68 wells x 75.5 AF/well = 5,134 AF
Dust Abatement Estimate: 0.64 AF/well x 68 = 43.5 AF
Total = 5,177.5 AF ÷ 10 years = **518 AF/Year**

Non-Horizontal Wells

Of the projected 800 federal wells, 60% are anticipated to be non-horizontal wells (n = 480)

Drilling and Completion Estimate: 480 wells x 2.5 AF/well = 1,200 AF

Total = 1,200 AF ÷ 10 years = **120 AF/Year**

Kremmling Field Office

Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, no federal wells are likely to be drilled over the next 10 year period within the Colorado River basin. All activity is anticipated to occur in the North Platte River basin.

FEDERAL TOTAL FOR THE COLORADO RIVER SUB-BASIN

21 + 788 + 349 + 18 + 649 + 518 + 120 = 2,463 AF/YR

Green River

In the Green River basin, the number of wells drilled from 2014-2016 was three. Instead of using this small sample size, the per well estimate for non-horizontal wells is based on the average of all of the 859 wells across the Action Area in Table 4 as follows:

Non-Horizontal Wells

Completion Estimate: Only freshwater used to complete the 859 wells = 6,753,731 bbls x 42 gal/barrel = 283,656,702 gal ÷ 325,851 gal/AF = 871 AF ÷ 859 wells = 1.0 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater. 6,753,731 bbls + 56,064,105 = 62,817,836 bbls x 42 gal/bbls = 2,638,349,112 gal ÷ 325,851 gal/AF = 8,097 AF x 7% = 567 AF ÷ 859 wells = 0.66 AF/well

Dust Abatement Estimate: 0.64 AF/well

Total = 1.0 + 0.66 + 0.64 = 2.3 AF/well

Little Snake Field Office and other Federal Mineral Estate within the administrative boundary of this field office

Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 7 federal wells could be drilled over the next 10 year period on all jurisdictions within the Green River basin.

Horizontal Wells
Of the projected 7 federal wells, one could be a horizontal well (n= 1)

Drilling and Completion Estimate: 1 well x 25.1 AF/well = 25.1 AF
Dust Abatement Estimate: 0.64 AF/well x 1 = 0.64 AF
Total = 25.8 AF ÷ 10 years = **2.6 AF/Year**

Non-Horizontal Wells
Of the projected 7 federal wells, 6 are anticipated to be non-horizontal wells (n = 6)

Drilling and Completion Estimate: 6 wells x 2.3 AF/well = 13.8 AF
Total = 14 AF ÷ 10 years = **1.4 AF/Year**

FEDERAL TOTAL FOR THE GREEN RIVER SUB-BASIN
2.6 + 1.4 = 4 AF/Year

Gunnison River

In the Gunnison River basin, the number of wells drilled from 2014-2016 was three. Instead of using this small sample size, the per well estimate for non-horizontal wells is based on the average of all of the 859 wells across the Action Area in Table 4 as follows:

Non-Horizontal Wells
Completion Estimate: Only freshwater used to complete the 859 wells = 6,753,731 bbls x 42 gal/barrel = 283,656,702 gal ÷ 325,851 gal/AF = 871 AF ÷ 859 wells = 1.0 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater. 6,753,731 bbls + 56,064,105 = 62,817,836 bbls x 42 gal/bbls = 2,638,349,112 gal ÷ 325,851 gal/AF = 8,097 AF x 7% = 567 AF ÷ 859 wells = 0.66 AF/well

Dust Abatement Estimate: 0.64 AF/well
Total = 1.0 + 0.66 + 0.64 = 2.3 AF/well

Uncompahgre Field Office, Grand Mesa, Uncompahgre, Gunnison National Forest, and other Federal Mineral Estate within these offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 250 federal wells are likely to be drilled over the next 10 year period on all jurisdictions.

Horizontal Wells
Of the 250 federal wells, 50% are anticipated to be horizontal wells (n= 125)

Drilling and Completion Estimate: 125 wells x 25.1 AF/well = 3,138 AF
Dust Abatement Estimate: 0.64 AF/well x 125 = 80 AF
Total = 3,218 AF ÷ 10 years = **321 AF/Year**

Non-Horizontal Wells
Of the 250 federal wells, 50% are anticipated to be non-horizontal wells = 125 wells x 2.3 AF/Well = 288 AF ÷ 10 years = **29 AF/Year**

Grand Junction Field Office, Grand Mesa, Uncompahgre, Gunnison National Forest, and other Federal Mineral Estate within these offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 100 federal wells are likely to be drilled over the next 10 year period on all jurisdictions.

Of the 100 federal wells, 100% are projected to be horizontal wells (n = 100)

Drilling and Completion Estimate: 100 wells x 25.1 AF/well = 2,510 AF
Dust Abatement Estimate: 0.64 AF/well x 100 = 64 AF
Total = 2,574 AF ÷ 10 years = **257 AF/Year**

FEDERAL TOTAL FOR THE GUNNISON RIVER SUB-BASIN
321 + 29 + 257 = 607 AF/Year

Dolores River
In the Dolores River basin, the number of wells drilled from 2014-2016 was three. Instead of using this small sample size, the per well estimate for non-horizontal wells is based on the average of all of the 859 wells across the Action Area in Table 4 as follows:

Completion Estimate: Only freshwater used to complete the 859 wells = 6,753,731 bbls x 42 gal/barrel = 283,656,702 gal ÷ 325,851 gal/AF = 871 AF ÷ 859 wells = 1.0 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater. 6,753,731 bbls + 56,064,105 = 62,817,836 bbls x 42 gal/bbls = 2,638,349,112 gal ÷ 325,851 gal/AF = 8,097 AF x 7% = 567 AF ÷ 859 wells = 0.66 AF/well

Dust Abatement Estimate: 0.64 AF/well
Total = 1.0 + 0.66 + 0.64 = 2.3 AF/well

Tres Rios Field Office, San Juan National Forest, and other Federal Mineral Estate within these offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 20 federal wells are likely to be drilled over the next 10 year period within the Dolores River basin on all jurisdictions.

Horizontal Wells
Of the 20 federal wells, 50% are anticipated to be horizontal wells (n = 10)

Drilling and Completion Estimate: 10 wells x 25.1 AF/well = 251 AF
Dust Abatement Estimate: 0.64 AF/well x 10 = 6.4 AF
Total = 257.4 AF ÷ 10 years = **26 AF/Year**

Non-Horizontal Wells
Of the 20 federal wells, 50% are anticipated to be non-horizontal wells = 10 wells x 2.3 AF/well = 23 AF ÷ 10 years = **2 AF/year**

Uncompahgre Field Office, Grand Mesa, Uncompahgre, Gunnison National Forest, and other Federal Mineral Estate within these offices administrative boundaries
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 30 federal wells are likely to be drilled over the next 10 year period on all jurisdictions.

Horizontal Wells
Of the 30 federal wells, none are anticipated to be horizontal wells.

Non-Horizontal Wells
Of the 30 federal wells, 100% are anticipated to be non-horizontal wells = 30 x 2.3 AF/well = 69 AF ÷ 10 years = **7 AF/Year**

FEDERAL TOTAL FOR THE DOLORES RIVER SUB-BASIN
26 + 2 + 7 = 35 AF/Year

White River
Non-Horizontal Wells

Completion Estimate: This is only using the freshwater amount data for the 220 wells = 750,304 bbls x 42 gal/barrel = 31,512,768 gal ÷ 325,851 gal/AF = 97 AF ÷ 220 wells = 0.44 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater = 750,304 bbls + 15,389943 bbls = 16,140,247 bbls x 42 gal/bbls = 677,890,374 gal ÷ 325,851 gal/AF = 2,080.3 AF x 7% = 146 AF ÷ 220 wells = 0.66 AF/well

Dust Abatement Estimate: 0.64 AF/well
Total = 0.44 + 0.66 + 0.64 = 1.74 AF/well

White River Field Office and other Federal Mineral Estate within the administrative boundary of this field office
Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 720 federal wells are likely to be drilled over the next 10 year period on all jurisdictions within the White River basin.

Horizontal Wells
Of the 720 federal wells, 80 could be horizontal wells. These 80 wells are in an area where freshwater use is anticipated to be higher due to local geology and very limited water recovery for water reuse. As such, the Action Area wide horizontal well estimate (25.1 AF/well) is not used and instead 51.6 AF/well is used as follows:

> Drilling and Completion Estimate: 80 wells x 51.6 AF/well = 4,128 AF
> Dust Abatement Estimate: 0.64 AF/well x 80 = 51.2 AF
> Total = 4,179.2 AF ÷ 10 years = **418 AF/Year**

Non-Horizontal Wells
Of the 720 federal wells, 640 are anticipated to be non-horizontal wells

> Drilling and Completion Estimate: 640 wells x 1.74 AF/well = 1,113.6 AF
> Total = 1,114 AF ÷ 10 years = **111 AF/Year**

White River National Forest
Based on the White River National Forests RFD of 487 wells 5% are projected to be located in the White River basin (n = 24) and of the 24 wells 10% would be horizontal wells (n = 2)

Horizontal wells

Drilling and Completion Estimate: 2 wells x 25.1 AF/well = 50.2 AF
Dust Abatement Estimate: 0.64 AF/well x 2 = 1.3 AF
Total = 51.5 AF ÷ 10 years = **5 AF/Year**

Non-Horizontal Wells = 22 wells x 1.74 AF/well = 38.3 AF ÷ 10 years = **4 AF/Year**

FEDERAL TOTAL FOR THE WHITE RIVER SUB-BASIN
418 + 111 + 5 + 4 = 538 AF/Year

Yampa River

Non-Horizontal Wells

Completion Estimate: This is only using the freshwater amount data for the 16 wells = 415,590 bbls x 42 gal/barrel = 17,454,780 gal ÷ 325,851 gal/AF = 54 AF ÷ 16 wells = 3.4 AF/well

Drilling Estimate: All water used for completions (fresh and recycled) x 7% with the assumption that the entire 7% amount for drilling is freshwater = 415,590 bbls x 42 gal/bbls = 17,454,780 gal ÷ 325,851 gal/AF = 54 AF x 7% = 3.8 AF ÷ 16 wells = 0.24 AF/well

Dust Abatement Estimate: 0.64 AF/well
Total = 3.4 + 0.24 + 0.64 = 4.28 AF/well

Little Snake Field Office and other Federal Mineral Estate within the administrative boundary of this field office

Based on the professional opinion of BLM's petroleum engineer and based on recent and projected trends, 140 federal wells could be drilled over the next 10 year period on all jurisdictions within the Yampa River basin.

Horizontal Wells

Of the 140 federal wells, 85% are projected to be horizontal wells (n = 119)

Drilling and Completion Estimate: 119 wells x 25.1 AF/well = 2,987 AF
Dust Abatement Estimate: 0.64 AF/well x 119 = 76 AF
Total = 3,063 AF ÷ 10 years = **306 AF/Year**

Non-Horizontal Wells

Of the 140 federal wells, 15% are projected to be non-horizontal = 21 wells x 4.28 AF/well = 90 AF ÷ 10 years = **9 AF/Year**

FEDERAL TOTAL FOR THE YAMPA RIVER SUB-BASIN
306 + 9 = 315 AF/Year

Total Annual Freshwater Depletion Threshold From Within the Action Area
2,463 + 4 + 607 + 35 + 538 + 315 = 3,962 AF/Year

Table 5. Annual Projected Water Use Amounts by Sub-Basin Based on 10-Year Outlook

River	Estimated Water Depletion (AF/Year)
Colorado River	2,463
Gunnison River	607
Dolores River	35
Yampa River	315
White River	538
Green River	4
TOTAL	**3,962**

While water use estimates are provided for each river sub-basin within the action area, the overall threshold amount (3,962 AF) is the amount being consulted on. All water use will be tracked and reported at the sub-basin level. Exceeding the estimated depletion amount in a given river sub-basin in a given year will not trigger re-initiation of consultation, but will require BLM to conference with USFWS to determine if effects, beyond those disclosed in this PBA, are affecting the endangered fish in that sub-basin.

V. Conservation Measures

As a means of minimizing negative effects associated with freshwater depletions, the following conservation measures are proposed as part of the proposed action:

- Water may be extracted directly out of the Colorado, Gunnison, White, Yampa, or Green River, which all have occupied and critical habitat for the four endangered big river fish. The following are measures to minimize direct impacts to federally listed species from pumping water directly out of these rivers:

  1. The best method to avoid entrainment is to pump from off-channel locations (e.g.,

ponds, lakes, and diversion ditches), not directly connected to the main-stem rivers even during high spring flows.

2. If the pump head must be located in the river channel where larval fish are known to occur (generally within Designated Critical Habitat), the following measures would apply:
   a. Do not situate the pump in a low-flow or no-flow area since these habitats tend to concentrate larval fishes. Instead place the pump into fast moving/riffle habitat.
   b. Limit the amount of pumping, to the greatest extent possible, during that period of the year when larval fish may be present (June 1 to August 15).
   c. Avoid pumping, to the greatest extent possible, during the pre-dawn hours (two hours prior to sunrise) as larval fish drift studies indicate that this is a period of greatest daily activity.

3. Screen all pump intakes with ¼ inch or finer mesh material.

4. Report any fish impinged on any intake screens to the Fish and Wildlife Service (970.243.2778) or Colorado Parks and Wildlife:

   Northwest Region
   711 Independent Ave.
   Grand Junction, Colorado 81505
   Phone: (970) 255-6100

   Southwest Region
   415 Turner Dr.
   Durango, CO 81303
   Phone: (970) 375-6700

This conservation measure will be implemented via the BLM working directly with the individual companies, their sub-contractors, and industry representative groups, to inform and educate on-the-ground personnel of the need to implement this conservation measure. In addition, the above conservation measure will be added to all Applications for Permit to Drill (APDs) as a condition of approval (COA) prior to commencement of development activity.

- Water depletion in the Colorado and Yampa River sub-basins has been addressed in programmatic biological opinions. These opinions require water users to sign Recovery Agreements that state the water users will not interfere with the implementation of recovery actions. The BLM will ensure Recovery Agreements are initiated by individual operators, or on the behalf of individual operators via industry representative groups, with the USFWS as appropriate.

- As a means of offsetting the impacts associated with the depletion of freshwater from the BLM's management of the federal fluid minerals program within the Action Area, the

BLM obtained a one-time monetary contribution from the industry representative group Independent Petroleum Association of Mountain States (now known as Western Energy Alliance) when the 2008 PBO was issued. The 2008 PBA/PBO analyzed water use over a 15-year timeframe; a payment of $71,978.34 was made to the National Fish and Wildlife Foundation on behalf of the Endangered Fish Recovery Program based on the 4,046 AF threshold identified in the 2008 consultation effort. Since the 2008 threshold was never exceeded, and the revised threshold in this re-consultation is below that amount, no new payment is required at his time. In December 2023 (the end of the 15-year timeframe addressed in the 2008 PBO), BLM will calculate a revised payment amount for 2024-2027, or another appropriate future timeframe, based on water use from 2017-2023 and other pertinent information.

VI. Description of the Species and their Habitat

VI.1 Bonytail

The Bonytail *(Gila elegans)* is a cyprinid fish endemic to the Colorado River Basin (Valdez and Clemmer 1982). Adult Bonytail are gray or olive colored on the back with silvery sides and a white belly. The adult Bonytail has an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a Humpback Chub. Adults attain a maximum size of about 550 mm total length (TL) (Bozek et al. 1984) and 1.1 kg in weight (Vanicek 1967). The Bonytail is listed as “endangered” under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*), under a final rule published on April 23, 1980 (45 FR 27710). A recovery plan was approved on September 4, 1990 (U.S. Fish and Wildlife Service 1990). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994.

Bonytail is one of four mainstem, big-river fishes currently listed as endangered under the ESA. The native fish assemblage of the Colorado River is jeopardized by large mainstem dams, water diversions – reduced flows, habitat modification, and nonnative fish species, and degraded water quality (Miller 1961; Minckley and Deacon 1968). An unknown, but small number of wild adults exist in Lake Mohave on the mainstem Colorado River of the Lower Colorado River Basin (i.e., downstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals in the Green River and upper Colorado River sub-basins of the Upper Colorado River Basin. Stocking of individuals has occurred in the Colorado River in DeBeque Canyon, and in Salt Creek west of Mack, Colorado.

Little is known about the specific habitat requirements of Bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys. The Bonytail is adapted to larger river systems where it has been observed in pools and eddies. Similar to other closely related *Gila* spp., Bonytail in rivers probably spawn in spring over rocky substrates; spawning in reservoirs has been observed over rocky shoals and shorelines. It is hypothesized, based on available distribution data that flooded bottomland habitats are important growth and conditioning areas for Bonytail, particularly as nursery habitats for young. Flow recommendations

have been developed that specifically consider flow-habitat relationships within historic habitat of Bonytail in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed habitat uses in various parts of the Colorado River Basin.

It has been suggested that the large fins and streamlined body of the Bonytail is an adaptation to torrential flows (Miller 1946; Beckman 1963). Of five specimens captured recently in the upper basin, four were captured in deep, swift, rocky canyon regions (i.e., Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in a reservoir (Lake Powell). Also, all fish taken from the lower basin since 1974 were caught in reservoirs. Specimens encountered in reservoirs are believed to inhabit their former habitats now inundated by these impoundments. Vanicek (1967) who handled numerous Bonytail detected no difference in habitat selection from roundtail chub. These fish were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. No quantitative data are available for the habitat of this species. Adult Bonytail captured in Cataract Canyon and Desolation/Gray Canyons were sympatric with Humpback Chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990).

Threats to the Species

The primary threats to Bonytail are streamflow regulation and habitat modification; competition with and predation by nonnative fishes; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002d). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to Bonytail in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado Pikeminnow. Threats to Bonytail in relation to hybridization are essentially the same threats identified for Humpback Chub discussed below.

VI.2 Colorado Pikeminnow

The Colorado Pikeminnow (*Ptychocheilus lucius*) is the largest cyprinid fish endemic to the Colorado River Basin (Tyus 1991). The common name for this species was changed from Colorado squawfish by the American Fisheries Society (Nelson et al. 1998). Adults attain a maximum size of about 1.8 m total length (TL) and 36 kg in weight (Miller 1961). Wild, reproducing populations occur in the Green River and upper Colorado River sub-basins of the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals (with limited reproduction) in the San Juan River sub-basin. The species was extirpated from the Lower Colorado River Basin in the 1970's but has been reintroduced into the Gila River sub-basin, where it exists in small numbers in the Verde River. The Colorado Pikeminnow is currently listed as “endangered” under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*). It was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The Colorado squawfish (Pikeminnow) was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received

protection as endangered under Section 4(c)(3) of the original ESA of 1973. The latest revised Colorado squawfish (Pikeminnow) recovery plan was approved on August 6, 1991 (U.S. Fish and Wildlife Service 1991). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994.

The Colorado Pikeminnow is a member of a unique assemblage of fishes native to the Colorado River Basin, consisting of 35 species with 74% level of endemism (Miller 1959). It is one of four mainstem, big-river fishes currently listed as endangered under the ESA; others are the Humpback Chub, Bonytail, and Razorback Sucker. The native fish assemblage of the Colorado River Basin is jeopardized by large mainstem dams, water diversions, habitat modification, nonnative fish species, and degraded water quality (Miller 1961; Minckley and Deacon 1991).

The Colorado Pikeminnow is a long-distance migrator; moving hundreds of kilometers to and from spawning areas. Adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats. Spawning occurs after spring runoff at water temperatures typically between 18 and 23°C. After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows.

Threats to the Species

The primary threats to Colorado Pikeminnow are competition with and predation by nonnative fishes; streamflow regulation and habitat modification; and pesticides and pollutants (USFWS 2002a). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. These impairments are described in further detail below.

Stream flow regulation includes mainstem dams that cause the following adverse effects to Colorado Pikeminnow and its habitat:

1. Block migration corridors.
2. Changes in flow patterns reduced peak flows and increased base flows.
3. Release cold water, making temperature regimes less than optimal.
4. Change river habitat into reservoir habitat.
5. In some cases, retaining sediment that is important for forming and maintaining backwater habitats.
6. In other cases, allowing sediment to build up due to lack in periodicity and magnitude of suitable flushing flows.

In the Upper Basin, 435 miles of Colorado Pikeminnow habitat has been lost to reservoir inundation from Flaming Gorge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado Pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to mainstem dams, many dams and water diversion structures occur in and upstream from critical habitat that

reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, majority of the river flow is diverted into unscreened canals. The high spring flows which maintain habitat diversity, flush sediments from spawning habitat, increase invertebrate food production, form gravel and cobble deposits important for spawning, and maintain backwater nursery habitats have been reduced by flow regulation of dams and by water diversions (McAda 2003; Muth et al. 2000).

Predation and competition from nonnative fishes have been clearly implicated in the population reductions or elimination of native fishes in the Colorado River Basin (Dill 1944; Osmundson and Kaeding 1989; Behnke 1980; Joseph et al. 1977; Lanigan and Berry 1979; Minckley and Deacon 1968; Meffe 1985; Propst and Bestgen 1991; Rinne 1991). Data collected by Osmundson and Kaeding (1991) indicated that during low water years, nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sportfishing, forage fish, biological control and ornamental purposes (Minckley 1982; Tyus et al. 1982; Carlson and Muth 1989). Nonnative fishes compete with native fishes in several ways. The capacity of a particular area to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in a smaller population of most species. The size of each species population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Some life stages of nonnative fishes appear to have a greater ability to compete for space and food and to avoid predation in the existing altered habitat than do some life stages of native fishes. Tyus and Saunders (1996) cite numerous examples of both indirect and direct evidence of predation on Razorback Sucker eggs and larvae by nonnative species.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (USFWS 2002a). Accidental spills of hazardous material into critical habitat can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Hamilton and Wiedmeyer 1990; Stephens et al. 1992; Hamilton and Waddell 1994; Hamilton et al. 1996; Stephens and Waddell 1998; Osmundson et al. 2000).

VI.3 Humpback Chub

The Humpback Chub (*Gila cypha*) is a large cyprinid fish endemic to the Colorado River Basin (Miller 1946). Adults attain a maximum size of about 480 mm total length (TL) and 1.2 kg in weight (Valdez and Ryel 1997). The Humpback Chub is currently listed as “endangered” under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*). It was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The Humpback Chub was included in the

United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received protection as endangered under Section 4(c)(3) of the original ESA of 1973. Six extant wild populations are known: (1) Black Rocks, Colorado River, Colorado; (2) Westwater Canyon, Colorado River, Utah; (3) Yampa Canyon, Yampa River, Colorado; (4) Desolation/Gray Canyons, Green River, Utah; (5) Cataract Canyon, Colorado River, Utah; and (6) the mainstem Colorado River in Marble and Grand Canyons and the Little Colorado River, Arizona. The first five populations are in the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam, Arizona), and the sixth population is in the Lower Colorado River Basin.

The latest revised Humpback Chub recovery plan was approved on September 19, 1990 (U.S. Fish and Wildlife Service 1990). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994.

The Humpback Chub is a member of a unique assemblage of fishes native to the Colorado River Basin, consisting of 35 species with 74% level of endemism (Miller 1959). It is one of four mainstem, big-river fishes currently listed as endangered under the ESA; others are the Bonytail, Colorado Pikeminnow; formerly Colorado squawfish; (Nelson et al. 1998), and Razorback Sucker. The native fish assemblage of the Colorado River Basin is jeopardized by large mainstem dams, water diversions, habitat modification, nonnative fish species, and degraded water quality (Miller 1961; Minckley and Deacon 1991).

The Humpback Chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. Populations of humpback chub are restricted to deep, swift, canyon-bound regions of the mainstem and large tributaries of the Colorado River Basin. Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used for spawning. Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C. Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions.

<u>Threats to the Species</u>
The primary threats to Humpback Chub are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pollutants (USFWS 2002c). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering.

VI.4 Razorback Sucker

The Razorback Sucker (*Xyrauchen texanus*) is a large catostomid fish endemic to the Colorado River Basin (Minckley et al. 1991). Adults attain a maximum size of about 1 m total length (TL) and 5–6 kg in weight (Minckley 1973). The Razorback Sucker is currently listed as “endangered” under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*), under a final rule published on October 23, 1991 (56 FR 54957). A recovery plan was approved on December 23, 1998 (U.S. Fish and Wildlife Service 1998). The final rule for determination of

critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994. Remaining wild populations are in serious jeopardy. Razorback Sucker are currently found in small numbers in the Green River, upper Colorado River, and San Juan River sub-basins; lower Colorado River between Lake Havasu and Davis Dam; reservoirs of Lakes Mead and Mohave; in small tributaries of the Gila River sub-basin (Verde River, Salt River, and Fossil Creek); and in local areas under intensive management such as Cibola High Levee Pond, Achii Hanyo Native Fish Facility, and Parker Strip.

The Razorback Sucker evolved in warmwater reaches of larger rivers of the Colorado River Basin from Mexico to Wyoming. Habitats required by adults in rivers include deep runs, eddies, backwaters, and flooded off-channel environments in spring; runs and pools often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools, and eddies in winter. Spring migrations of adult Razorback Sucker were associated with spawning in historic accounts and a variety of local and long distance movements and habitat use patterns have been documented. Spawning in rivers occurs over bars of cobble, gravel, and sand substrates during spring runoff at widely ranging flows and water temperatures (typically greater than 14^{o}C). Spawning also occurs in reservoirs over rocky shoals and shorelines. Young require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated floodplain habitats in rivers, and coves or shorelines in reservoirs. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Razorback Sucker in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed uses in various parts of the Colorado River Basin.

Adult Razorback Sucker tend to occupy different habitats seasonally (Osmundson et al. 1995; Table A-1), and can do well in both lotic and lentic environments (Minckley et al. 1991). In rivers, they usually are captured in lower velocity currents, more rarely in turbulent canyon reaches (Tyus 1987; Lanigan and Tyus 1989; Tyus and Karp 1990; Bestgen 1990; Minckley et al. 1991). An exception may be in the San Juan River, where hatchery-reared, radio-tagged adults preferred swifter mid-channel currents during summer–autumn base-flow periods (Ryden 2000). In the upper basin, bottomlands, low-lying wetlands, and oxbow channels flooded and ephemerally connected to the main channel by high spring flows appear to be important habitats for all life stages of Razorback Sucker (Modde et al. 1996; Muth et al. 2000). These areas provide warmwater temperatures, low-velocity flows, and increased food availability (Tyus and Karp 1990; Modde and Wick 1997; Wydoski and Wick 1998). For example, in Old Charlie Wash, a managed wetland on the middle Green River, spring–summer water temperatures were 2–8°C higher than in the adjacent river (Modde 1996; Modde and Wick 1997), density of benthos was 41 times greater than in other sampled habitats, and densities of zooplankton were 29 times greater than in backwaters and 157 times greater than in the main channel (Mabey and Shiozawa 1993).

Threats to the Species

The primary threats to Razorback Sucker are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; and pesticides and pollutants (USFWS 2002b). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to Razorback Sucker are essentially the same threats identified for Colorado Pikeminnow discussed above.

VII. Environmental Baseline (Status of the Species in the Upper CO River Basin)

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed State or Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation process. The Action Area is defined at 50 CFR 402 to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action". For the purposes of this consultation, the Action Area has been defined to include federal, state, tribal, and private lands overlaying federal subsurface fluid mineral estate administered by the BLM within the Colorado River Basin, excluding the San Juan River basin. The action area includes occupied habitats located downstream that may be affected by water depletions associated with the proposed action.

A number of federal, state, and private actions and activities contributed historically to the decline of these four endangered fish species, including changes in flow regimes associated with construction of dams, trans-basin water diversions, municipal water use, and agricultural irrigation diversions. Altered water quality, including in some cases reduced sediment loads and lower temperatures associated with impoundments, while in other cases excessive sediment loading due to reduced conveyance/flushing flows, chemical pollutants (most notably mercury and selenium). Loss of habitat complexity due to impoundments, reduced flows, in some cases reduced sediments and in others excessive sediment loading and channel constriction. Nonnative fish introductions which result in competition for limited resources including preferred microhabitats (backwaters, side channels, spawning areas, flooded bottomlands, tributaries), and food, direct mortality resulting from predation on eggs, larvae, juvenile, and adult fish by predatory game and nongame fish species such as Northern Pike, Smallmouth Bass, and Walleye, hybridization with similar species (e.g. White Sucker and Razorback Sucker hybrids).

In 2002, the USFWS developed Recovery Goals (USFWS 2002 a-d) for each species to supplement the individual endangered species recovery plans. The Recovery Goals contain specific demographic criteria to maintain self-sustaining populations and recovery factor criteria that would indicate when threats to the species would be ameliorated. A minimum viable population is identified for each species as a gauge for recovery. In addition, key requirements of the population criteria include no net loss of fish over established monitoring periods, and recruitment of young fish into the adult population must occur at a rate to maintain the population. Significant changes in the status of the four species generally are not detected on a year-to-year basis due to species' life history (i.e., recapture rates over long lifespan) as well as variable confidence intervals around population estimates and the potential influence of sampling on

capture probability. Since the Recovery Goals were completed in 2002, the Recovery Programs, the Glen Canyon Dam Adaptive Management Program, and the Lower Colorado River Multi-Species Conservation Program have gathered new information and a greater understanding about the endangered fishes ecological needs, population dynamics, and how to manage threats. The Recovery Program is currently working with the USFWS to update recovery plans (including the 2002 Recovery Goal) for the Colorado Pikeminnow and Humpback Chub, and possibly for the Razorback Sucker (see discussion of pending 5-year Status Reviews below).

Hatchery-produced, stocked fish form the foundation for the reestablishment of naturally self-sustaining populations of Razorback Sucker and Bonytail in the upper Colorado and Green River systems (Figure 1). The Recovery Program has been implementing an integrated stocking plan (Nesler et al. 2003) with the goal of establishing self-sustaining populations of Razorback Sucker and Bonytail in the upper Colorado River basin. The Recovery Program has been largely successful in meeting the plan's annual stocking targets. Stocked Razorback Sucker are reproducing and wild juvenile Razorback Suckers are starting to be captured. Recaptures of stocked Bonytail are rarer. However, increasing numbers of Bonytail have been detected by stationary PIT-tag reading antennas and traditional sampling methods throughout the upper Colorado River basin. A more rigorous assessment of Bonytail recapture information should be one of the first queries of the Recovery Program's new STReaMS database. Survival of stocked Bonytail may be improving or the relatively new stationary antennas may be a better method of detecting stocked fish than other, ongoing active sampling methods. The stocking plan was recently revised to stock fewer and larger razorback sucker and more and larger Bonytail (Integrated Stocking Plan Revision Committee 2015).

In 2015, species status assessments (SSAs) were initiated for Humpback Chub and Razorback Sucker. In addition, a population viability analysis (PVA) was initiated for Colorado Pikeminnow, which will contribute to an SSA for that species. All three SSAs are scheduled for completion in FY17. The SSA is an analytical tool used by the Service to summarize biological and ecological information that can help inform a variety of decisions and activities under the Endangered Species Act, including recovery planning, species status reviews, inter-agency consultations, and species reclassifications. The framework of an SSA considers species needs, species current condition, and species viability. The SSA is not a decision document. However, the SSAs will streamline and serve as the basis for the next 5-year Status Reviews to be completed in 2017. The 5-year Status Reviews will include the Service's decision on the need for revision of species' recovery plans and whether the agency will explore a re-classification.

The recently completed *Final 2015-2016 Assessment of Sufficient Progress Report* (USFWS 2017) provides the most up-to-date and in depth summary of the environmental baseline for each species within the Action Area. See the following link for specifics:
http://www.coloradoriverrecovery.org/documents-publications/foundational-documents/recovery-action-plan.html

VIII. Effects of Proposed Action

The Proposed Action accounts for projected federal fluid mineral activity and freshwater use in the Action Area, and the accounting and reporting of actual freshwater used annually for drilling,

and completion of all federal wells and related activities. Based on the number of federal wells anticipated, it is estimated that BLM's administration of the fluid mineral program will result in an average annual depletion of 3,962 AF within the Action Area. While this estimate is slightly lower than the estimate derived in the 2008 PBA, based on BLM's tracking and reporting, the 2008 estimate appears to have been an overestimate. Between 2009 and 2016, water use never exceeded 971 AF/year.

VIII.I Direct Effects and Indirect Effects

Adequate water flow at different life-stages is essential to these endangered fishes. Reduction in water quantity reduces the ability of the river to create and maintain the primary constituent elements that define critical habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of flows brought about by water depletions. Sufficient water flows at varying times of year are critical to these fish in order to meet all of their life history requirements. The USFWS has determined minimum streamflow requirements for these fish species within select portions of their DCH. These flows have been determined to be the minimums needed to provide these fish the primary constituent elements required to successfully spawn, reproduce, and recruit into the adult population. The sub-basin river reaches noted in Table 1 provide DCH for these fish. Of particular importance is the 15-Mile Reach located in the Colorado River basin from its confluence with the Gunnison River in Grand Junction, Colorado upstream 15 river miles to Palisade, Colorado. This reach is known as a spring congregation/spawning area for adult Colorado Pikeminnow and Razorback Sucker.

Water Withdrawals Directly from Occupied Habitats

The potential exists for water intake structures placed on any of the occupied river reaches including the Colorado, Green, Gunnison, White, and Yampa Rivers to result in direct mortality to eggs, larvae, young-of-the-year, and juvenile life stages. Endangered larval fish are very small (<0.5 inches total length) and incapable of directed swimming from the time of hatching through the first 2-4 weeks of their life. Depending on the water year, larval fish may be present in occupied habitats from as early as April 1 to as late as August 31 (earlier in dry years; later in wet years). To offset these potential impacts, the BLM will continue to work with operators to implement the Conservation Measure identified in Section V.

Peak (Spring) Flows

All of these fish are spring spawning species and sufficient spring flows (March – July) are needed to inundate preferred and identified spawning sites and river substrates (primarily cobbles), periodically flush sediments from spawning substrates, and maintain and create important microhabitats including backwaters, flooded bottomlands, side channels, oxbows, eddies, and in some cases isolated off channel pools and impoundments. Both spring and summer flows are critical in influencing quality and quantity of spawning habitat for Colorado Pikeminnow and Razorback Sucker (Osmundson and Kaeding 1991). In addition, periodic flows that inundate floodplains and stimulate riparian vegetation recruitment and regeneration are important to provide river bank stability, cover, shading, organic inputs, and increased habitat diversity and complexity.

Spring peak flows are important for channel maintenance and efficient conveyance of sediments.

Coupled with a reduced flow regime, sediment input rates are likely to exceed transport rates and sediment depositional problems (aggradation) are likely to occur with time (Reiser et al. 1989). Reductions in springtime flows allow fine sediments to build up which reduces habitat complexity and diversity as river channels narrow, and backwater habitats are cut off from the main channel, and side channels are reduced in abundance and quality. Excessive sediment can impact recruitment of young fish as important low and zero velocity micro-habitats, primarily backwaters, oxbows, and flooded bottomlands are reduced in quantity or quality. Accumulation of fine sediments can also reduce spawning substrate quality and usability which can impact successful reproduction and recruitment. A number of trans-basin diversions have impacted the Colorado River for over 100 years; diverting about 475,000 AF of water from the Colorado River basin to the East Slope each year (Denver Water). From 1975 to 2015, exports (trans-basin diversions), agricultural uses, municipal uses, evaporative losses, livestock, and mineral uses have collectively depleted a running average of 1,500,000 AF annually from above the 15-Mile Reach in the Colorado River (CWCB Unpublished Data 2017). Research suggests that rain on snow events could result in earlier and increased magnitudes of peak flows (over current peaks, not necessarily historic peaks) but for a much shorter duration then the natural hydrograph (Barnett et al. 2005). Agricultural water diversions take large volumes of water from all of the Action Area river basins and account for 89% of all consumptive water use in the state (CO Water Plan 2015).

Base (Fall – Winter) Flows

Sufficient base flows (August – February) are important for these fish in order to maintain backwater habitats and depths of these habitats sufficient to provide for winter refugia for small fish to successfully overwinter, as well as provide for periodic connectivity to microhabitats created during spring peak flow events (isolated pools, oxbows, and flooded bottomlands).

Reduced base flows can impact these fish by reducing the depth of low and zero velocity microhabitats important for adult and young fish, especially those going into their first winter. Reduced depths of backwaters results in less available habitat, crowding, and competition for limited food and space, as well as potential for freezing of water to the point where habitat is substantially reduced, or is unusable.

At the time flow recommendations within the 15-Mile Reach were initially made, base flows were not of concern for these fish in the Colorado River basin (Osmundson and Kaeding 1991). Given this, Osmundson and Kaeding (1991) in their flow recommendation report suggested that mean monthly winter flows through the 15-Mile Reach remain at or above historic levels - averaging approximately 1,470 cubic feet/second (cfs). Average of all base flows from August to February (2006 to 2016) was 1,558 cfs at the USGS Grand Valley Diversion Gauging Station near Palisade, CO. Individual monthly mean flows at this station varied with some monthly means below the recommended 1,470 cfs in the fall months of August, September, and October. Flows in winter were all above the recommended flow. (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Based on monthly flow data, freshwater depletions occurring during the spring and summer months (March - September) are likely to be more impactful to these fish than water depletions occurring during the winter months (November through February). Opportunities to withdraw water during the winter months could help reduce effects.

Selenium and Mercury

These two elements are suspected to negatively affect all four of these long lived endangered fishes (Hamilton 1999, Hamilton et al. 2000, Osmundson and Lusk 2016). Sources of selenium are primarily associated with natural geology as it is concentrated in marine shales - primarily Mancos, Green River, and Lewis shales (USGS 2017). Selenium is an essential element and there is a fine line between amounts needed for survival and amounts that can cause harm. Generally amounts above 8 mg/g dry weight for muscle tissue and 4 mg/g for whole body are of concern (Lemly 1996). The new EPA criterion for selenium is 8.5 mg/kg dry weight for whole body fish, 11.3 mg/kg dry weight for fish muscle, and 15.1 mg/kg dry weight for fish eggs/ovaries (EPA 2016). It has the potential to become problematic to fish due to extensive conversion of arid land to irrigated land which has exacerbated transport of selenium to waterways. Within the Action Area, the Gunnison sub-basin contains the highest amounts of selenium based shale soils and irrigated agriculture, and is the focus of work being conducted by the Gunnison Basin and Grand Valley Selenium Task Forces. A study analyzing selenium concentrations from fish tissue collected from the Gunnison River within DCH for Colorado Pikeminnow and Razorback Sucker, noted elevated levels of selenium (Osmundson 2017). Selenium is mainly bioacummulated by fish through the food chain (Lemly 1996). Selenium is known to cause effects to fish including malaise, reduced feeding, lethargy, organ damage, developmental abnormalities, and reduced fecundity and reproductive success (Hamilton 2004, Janz et al. 2010). Selenium is readily reduced in concentration by improved dilution, and higher flows may reduce selenium concentrations in fish (Osmundson et al. 2000).

Mercury is a naturally occurring but non-essential toxic metallic element. It can be found in soils and the atmosphere, as well as water bodies. Mercury is emitted by both natural and anthropogenic sources. Natural sources include volcanoes, geothermal sources, and exposed naturally mercury-enriched geological formations. These sources may also include re-emission of historically deposited mercury as a result of escape from the surface back into the atmosphere, fires, meteorological conditions, as well as changes in land use and biomass burning. Anthropogenic sources of mercury include burning of fossil fuels, incinerators, mining activities, metal refining, and chemical production facilities. Anthropogenic mercury emissions now far surpass those derived from natural processes (Fitzgerald et al., 2005; Pacnya et al. 2010; UNEP 2013; Driscoll et al. 2013). The global emissions inventory for 2010 estimated that 1,960 metric tons 4,319,840 lbs) of mercury was emitted into the atmosphere as a direct result of human activity (UNEP 2013), with approximately 61 metric tons supplied by North America. East and Southeast Asia were by far the highest contributors, with 777 metric tons of mercury released (UNEP 2013).

Atmospheric transport and deposition is an important mechanism for the global deposition of mercury (EPRI 2014), as it can be transported large distances across continents from its source regions. It is considered a global pollutant. Atmospheric mercury is primarily inorganic and although inorganic mercury is widespread across the landscape, it is not biologically available to fish until it’s converted into methyl mercury (MeHg). It is converted into MeHg through a process known as methylation when microbial organisms in sediment, algal mats, or periphyton biofilms methylate inorganic mercury species into organic species (Marvin-DiPasquale et al. 2009; Tsui et al. 2009, 2010). Several variables can affect MeHg production including land use/cover, local

geology, soil properties, discharge, and redox conditions (Shanley et al. 2005). Water bodies such as reservoirs and wetlands that experience year to year variation in water levels and intermittent plant growth and decay are especially susceptible to the conversion of inorganic mercury to biologically available MeHg (Shanley et al. 2005; Willacker et al. 2016).

Reducing the ability of ambient amounts of inorganic mercury to convert to biologically available MeHg is the best method by which to reduce harmful effects to aquatic species. As compared to selenium, increased flows (dilution) has limited influence on MeHg once it is in solution as fish accumulate MeHg mostly from their diet, though some waterborne MeHg can be passed over the gills and accumulated (Sandheinrich and Wiener 2011; Wiener and Spry 1996). Mercury ingested in food bioaccumulates over time into fish tissues and concentrations generally increase with increasing age of fish or body size. Biomagnification (increased tissue concentrations as the chemical is passed up through two or more trophic levels) is exacerbated by a very slow release time of mercury from the body. Because mercury biomagnifies up food webs, fish at higher trophic levels usually contain greater concentrations than coexisting species at lower trophic levels (Beckvar et al. 2005; Peterson et al. 2007; Sandheinrich and Wiener 2011).

Because Colorado Pikeminnow are long lived top predators, they are especially susceptible to bioaccumulation via biomagnification of MeHg (USFWS 1994). MeHg concentrations in fish muscle tissues above 0.2 mg/g are associated with potential impairment of fish (Beckvar et al. 2005). Lusk (2010) describes the potential effects of MeHg to fish as:

1. Potent neurotoxin:
    a. Affects the central nervous systems (reacts with brain enzymes, then lesions)
    b. Affects the hypothalamus and pituitary, affects gonadotropin-secreting cells
    c. Altered behaviors: Reduced predator avoidance, reproduction timing failure
    d. Reduced ability to feed (emaciation and growth effects)
2. Endocrine disruptor
    a. Suppressed reproduction hormones in male and female fish
    b. Reduced gonad size and function, reduced gamete production
    c. Altered ovarian morphology, delayed oocyte development
    d. Reduced reproductive success
    e. Transfer of dietary Hg of the maternal adult during oogenesis and into the developing embryo
3. Inability to grow new brain cells or significantly reduce mercury levels from brain tissues.

Osmundson and Lusk (2016) recently reported elevated mean mercury concentrations in Colorado Pikeminnow muscle tissue from all sampled specimens and locations within the Upper Colorado River Basin at 0.54 mg/g wet weight; the highest concentrations were from the largest adults collected from the Green River and Colorado River sub-basins. A recent meta-analysis of all the historic mercury data from the Upper Colorado River Basin by USGS found that Colorado Pikeminnow and Roundtail Chub had the highest mean mercury concentrations of all fish sampled (0.40 mg/g wet weight and 0.35 mg/g wet weight, respectively). They also found that Colorado Pikeminnow, and an important native forage species Speckled Dace, had the highest mean selenium concentrations (3.71 mg/g and 3.27 mg/g wet weight, respectively) (USGS 2017 unpublished data).

Mercury is a global pollutant and remediation is largely beyond the scope of the Recovery Program (USFWS 2014). However, any targeted actions within sub-basin watersheds that would reduce conversion of inorganic mercury to biologically available MeHg would be helpful (vegetation removal in reservoirs after spring/summer releases, keeping wetlands flooded vs. annual or periodic drying and rewetting, etc.).

Both selenium and mercury are found within the sub-basin watersheds within the Action Area and are impacting the endangered fish to varying degrees. As related to management of the federal fluid mineral program, the depletion of freshwater does not result in increased inputs of either chemical. Reduced flows associated with freshwater depletions from development of federal fluid minerals within the Action Area could exacerbate the effects of selenium and mercury on these fish as reduced flows could lessen beneficial dilution effects on concentrations of each chemical in a given river. For instance, if the freshwater source that is depleted contains no or very low background amounts of selenium or mercury, this could reduce the dilution benefits to the larger river; or if water is depleted from a source higher upstream in the watershed that contains a lesser concentration of either or both chemicals as compared to downstream, this could also lessen dilution benefits associated with increased flow of water with lower concentrations of either selenium or mercury or both.

Nonnative Fishes

Reduced water flows can create habitat conditions preferred by introduced nonnative fishes. Many introduced fishes prefer warmer, shallower water conditions which result from decreased flows which could negatively affect the four endangered fishes via increased competition, predation, and in the case of the Razorback Sucker, hybridization (with nonnative White Suckers). Reduced flows create habitats in which nonnative fish can thrive and out-compete the endangered fishes for limited resources including food and space. More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sport fishing, forage fish, biological control, and ornamental purposes (Minckley 1982; Tyus et al. 1982). The capacity of any water to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in smaller populations of most species. The size of each species population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Osmundson and Kaeding (1991) indicated that during low flow water years (1986-1989), nonnative minnows (Red Shiners, Fathead Minnow, and Sand Shiners) capable of preying on or competing with larval endangered fishes greatly increased in numbers. Nonnative fishes responded positively (population increases) to sustained low summer flows (Propst and Gido 2004). Additional research by Propst et al. (2008) suggests that chronic presence of nonnative fish, coupled with naturally low flows reduced abundance of individual species and compromised persistence of native fish assemblages. Propst et al (2008) also found that native fish density was greatest during wet periods and declined during dry periods.

While reduced flows in relation to nonnative fish abundance is a concern, it is primarily the presence of numerous species of nonnative fishes that is impacting the four endangered fish. Top predators such as the Northern Pike, Smallmouth Bass, and Walleye are of particular concern due to their potential to prey upon the endangered fish. Northern Pike and Colorado Pikeminnow have very similar habitat and niche preferences and thus compete directly for food and habitat. White

Sucker have the potential to hybridize with Razorback Sucker which can reduce genetic purity. The USFWS (2016) states that the main cause for the recent declines in Colorado Pikeminnow populations throughout the Green River basin, which includes the White and Yampa river basins, is persistent competition and predation from nonnative predatory species (Northern Pike, Smallmouth Bass, and Walleye), and similarly, nonnative predation and competition is currently considered the greatest threat to the Colorado Pikeminnow population in the Colorado River basin which includes the 15-Mile Reach.

Climate Change

Climate change is a global phenomenon caused primarily by the release of greenhouse gases into the earth's atmosphere. Water depletions associated with development of federal fluid minerals would not result in increased greenhouse gas emissions. The majority of research on climate change involves the use of predictive modeling efforts to inform the expected level of change into the future. The most widely accepted climate models predict that climate change could reduce Colorado River Basin average annual flow from 5 to 20 percent by 2050 (Ray et al. 2009). Other predicted impacts include increased drought frequency and severity which could result in reduced streamflow (Barnett et al. 2008; Woodhouse et al. 2016). Research suggests that rising temperatures due to climate change are already reducing stream flows in the Colorado River basin (Woodhouse et al. 2016). General effects of a warmer climate include reduced snowpack, reduced discharges, and changes in timing, intensity, and duration of spring peak flows. Since the late 1970's, the onset of snowmelt in the Upper Colorado River Basin has shifted 2 to 3 weeks earlier coincident with increasing spring temperatures and declining snowfall (Clow 2010). Climate projections indicate that snowmelt timing will continue to advance in response to additional warming (Rauscher et al. 2008). The observed trends in snowmelt timing have resulted in a similar shift in streamflow timing. Increased air temperatures alone are a major factor in reducing surface-water flows in this region (USGS 2011). Other potential effects include greater evaporation losses in the larger reservoir systems that feed occupied river reaches which could reduce current flexibility of operations (flow releases to benefit these endangered fishes). A drier climate could also cause irrigators to call on existing water rights more frequently resulting in reduced flows (USFWS 2011). Reduced flows within the Action Area are likely to make it more difficult to meet the minimum flow requirements for the endangered fish. Reduced flows from water depletions associated with the proposed action would exacerbate these effects to a small degree.

Additional research and information as to potential effects of climate change on these four endangered fish species is extremely limited. The vast majority of climate change research has focused on effects to coldwater dependent fish species versus warmer water species. In addition to the overall effects of reduced flows, changes in timing of flows and associated changes in timing of seasonal water temperatures could have some limited but potentially beneficial effects for the endangered fish. The endangered fish initiate spawning in the spring based primarily on water temperature cues. As snowpack melts earlier in the spring water temperatures will warm up earlier in the spring as well. This could benefit these species, as spawning is likely to be initiated earlier in the spring which would provide a longer growing season for age-0 fish to grow and accumulate fat reserves heading into their first winter. This could improve overwinter survival of age-0 fish that go into winter at larger sizes with more caloric reserves (Thompson et al. 1991). In addition, fish would be larger and better equipped to compete for limited habitat and food resources and less

vulnerable to predation.

In addition, water depletions in association with climate change could expand the ranges of these fish. The current upstream distributional extent for these fish are limited primarily because of summer seasonal temperatures that are too cold for most warm season (April – October) life history requirements. As upstream river reaches gradually warm it is possible that these reaches will be able to provide for the full suite of life history requirements for these fish and use of these river segments by these endangered fishes could increase. However, these potential geographic expansions in range could also be taken advantage of by select nonnative fishes that may be somewhat temperature limited which would limit potential benefits.

Accidental Spills of Contaminants
Another threat to these fish is the potential for accidental spills or leaks of contaminants either directly or indirectly (via tributary streams) into occupied habitats. The depletion of water associated with federal fluid mineral development would be unlikely to result in any potential contaminant releases. However, water depletions and reduced flows associated with federal fluid mineral development could exacerbate the effects of potential contaminant spills. In general, dilution is the means by which the harmful effects to the four endangered fishes from any potential contaminant would be reduced. Reduced flows would lessen dilution effectiveness and could result in contaminant concentrations at levels capable of causing greater intensity of impacts or impacts for a greater duration and distance downstream than if dilution amounts were greater. Impacts from spills are impossible to predict and depend on several factors including the chemical released, distance to live water, time of travel once in water, chemical amounts, time of year, flows, and stream and air temperatures, among others. Effects can range from sub-lethal (malaise, reduced feeding, lethargy, habitat avoidance, displacement, etc.) to lethal (direct mortality). Generally, the effects of spills are localized and temporary. Given the small reductions in water volume in rivers within the Action Area associated with water depletions addressed in this document, substantial changes in contaminant concentration would be small as well.

Flow Augmentation (as a means of offsetting identified impacts)
Impacts from water depleting activities within the Action Area are being offset to a degree via flow augmentation efforts. The Upper Colorado River Endangered Fish Recovery Program, among other activities, purchases water rights and works with water rights holders and water managers, the Bureau of Reclamation, and local water authorities throughout the Action Area to establish and coordinate flow releases out of reservoirs (Granby, Windy Gap, Willow Creek, Williams Fork, Reudi, Green Mountain, Wolford, Elkhead, Flaming Gorge) specifically to benefit the endangered fish during critical times (USFWS 2016). While recommended water flows for these fish are generally met, at times (most recently: 2012, 2013, August and October in 2015) they were not met even with flow augmentation. It is possible that recommended flows may be more difficult to attain into the future with occurring and projected climate change impacts coupled with projected increased municipal and industrial water demands (Woodhouse et al. 2016). Recent periods of non-attainment of recommended flows are primarily during spring and summer months. The most critical time period for these fish is spring as sufficient flow is needed to provide for migration to spawning congregation areas, inundation of spawning substrates, and periodic flushing of sediments from spawning substrates. However, in select circumstances, reduced base

flows may also be of concern. Based on the water year, the Recovery Program would work with partners to augment flows and minimize effects from reduced flows at identified times of year.

Summary and Context of Effects

In summary, all water depletions within the Action Area are considered to have adverse effects to the four endangered fishes and their critical habitats. The effects associated with depletions from the development of federal fluid minerals are discussed and disclosed above and are likely to occur over the 10 year analysis timeframe. However, no degree of magnitude or intensity of those effects specific to the Proposed Action has been assigned. The magnitude and intensity of those impacts in context with other consumptive water uses within the Action Area that are affecting rivers and these endangered fish is discussed below.

A number of trans-basin diversions have impacted the Colorado River for over 100 years; diverting about 475,000 AF of water from the Colorado River basin to the East Slope each year (Denver Water). From 1975 to 2015, exports (trans-basin diversions), agricultural uses, municipal uses, evaporative losses, livestock, and mineral uses have collectively depleted a running average of 1,500,000 AF annually from above the 15-Mile Reach in the Colorado River (CWCB Unpublished Data 2017). Based on our projected annual freshwater use estimates over the next 10-year period of 2,463 AF within the Colorado River sub-basin, BLM's fluid minerals program would account for just 0.16% of the 1.5 million AF of total annual consumptive use.

At a broader statewide scale, in the Colorado Water Plan (2015), water depletions associated with the development of federal fluid minerals is lumped into the category of Industrial Use (specifically Large Industry) regarding consumptive water use within the state. Within this category, federal fluid mineral water depletions are a subset of the energy and mining extraction industry. Other large industries include beer brewing, snowmaking, power generation, food processing, and a multitude of others. Collectively, the Large Industry category currently requires approximately 200,000 AF of water annually. Broader state-wide projections indicate that future large industry needs could increase by an additional 50,000 to 130,000 AF per year by 2050 (CO Water Plan 2015). BLM's water use projections for its fluid minerals program in western Colorado (3,962 AF annually), represents 2% of the current Large Industry portion of water depletions. Large Industry currently accounts for 4% of all consumptive use occurring across the state. When compared to the total amount of annual consumptive use from all uses including Agricultural (89%), Municipal (7%), and Industrial (4%) across the state (5.3 million AF) the amount of freshwater use associated with the development of federal fluid minerals annually is 0.07% of the total consumptive use in the state.

Water depletions associated with development of federal fluid minerals over the next 10-year period is a small percentage of all consumptive water use occurring and projected to occur within the Action Area. As compared to other consumptive uses of freshwater, including agricultural and municipal water depletions from within or affecting the Action Area, impacts to the four endangered fish associated with water depletions from development of federal fluid minerals are extremely limited in their magnitude and intensity and would be difficult to measure or quantify. Regardless, the additive effects of these water depletions are addressed above and would be likely to occur within occupied habitat for these four endangered fishes over the analysis period of 10

years.

VIII.II Cumulative Effects

Cumulative effects, under the ESA, include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological assessment. Future Federal actions that are unrelated to the proposed action are not considered in cumulative analysis because they will be subject to separate consultation pursuant to Section 7 of the ESA.

The scope of analysis for cumulative impacts for the four endangered big river fishes takes in the entire Action Area and the Colorado River downstream to the Lake Powell inlet. This includes, private and state lands to account primarily for cumulative effects on Colorado Pikeminnow, Razorback Sucker, Bonytail, and Humpback Chub associated with water depletions and the effects associated with those depletions.

Water diversions to manage water for human uses, including irrigation for crops, livestock, and domestic uses has been occurring for decades. As population centers within the planning area and beyond, such as Denver, continued to grow and expand, water demand increased. Western Colorado is considered "water rich" as 80% of the state's annual water falls as snow precipitation west of the Continental Divide. Conversely, Colorado's Front Range including Denver and its suburbs, Colorado Springs, Fort Collins, and Pueblo contains greater than 80% of the state's human population. Several dams and reservoirs and large trans-basin water diversions were constructed to take water from headwater streams within the Colorado River Basin and move it through the Continental Divide to Front Range municipalities. Many of these water diversions and water rights are still in place today and have resulted in impacts on stream and river flows, within the Upper Colorado River basin. These activities have impacted all four of the endangered fish and their habitats by altering timing and magnitude of peak flows, reducing overall flows, increasing sediment aggradation, accelerating habitat alteration, and reducing habitat complexity and diversity.

It is reasonable to expect that these activities and the associated impacts are likely to occur and intensify in the foreseeable future on private, state, and other non-federal lands within the state. Colorado's human population is predicted to nearly double by 2050 which will require increased municipal water use. Data in the Colorado Water Plan (2015), suggests the Green, Yampa, and White river basins' municipal and industrial water demands will increase by between 34,000 and 95,000 AF by 2050, depending on the rate of population growth. By 2050, municipal and industrial water demand in the Gunnison River basin is projected to increase between 16,000 and 23,000 AF with passive conservation included. The Colorado River basins' municipal and industrial water demands are anticipated to increase by 65,000 – 110,000 AF by 2050 depending on population growth. The Southwest basins, which include the Dolores River basin, are expected to have municipal and industrial water needs of an additional 20,000 – 31,000 AF by 2050.

Agricultural water uses are expected to be maintained or slightly reduced as water uses are shifted from agriculture to other consumptive uses. Activities on private and State lands that are likely to affect river flows within the Action Area include private fluid mineral development, continued

agricultural irrigation, human population increases and increased urban development resulting in increased municipal water needs and uses, various recreational activities, livestock grazing, and other large industrial uses. All of these activities will result in increases in consumptive use of freshwater and result in reduced river flows and associated impacts to the four endangered fishes within and downstream of the Action Area.

IX. Determination of Effects

Upon consideration of the current status of the endangered big river fishes; the environmental baseline for the Action Area for each species; and the direct, indirect, and cumulative impacts, as well as the conservation measures identified to reduce potential effects, it is BLM's biological assessment that freshwater depleted by activities associated with administration of the federal fluid mineral program within the Action Area in western Colorado: "**MAY AFFECT, LIKELY TO ADVERSELY AFFECT"** the Endangered Colorado Pikeminnow, Razorback Sucker, Bonytail, and Humpback Chub. Furthermore, the depletions of freshwater associated with the federal fluid minerals program "**MAY AFFECT, LIKELY TO ADVERSELY AFFECT"** Designated Critical Habitat for these four endangered fish.

Rationale:

All water depletions from within the Upper Colorado River basin have been determined to result in a "May Affect" determination.

X. Conclusion

Colorado BLM is consulting with USFWS on an annual depletion amount of 3,962 AF for the entire Colorado River basin excluding the San Juan River basin, which was determined based on an average annual depletion amount anticipated to occur during the next 10 years within the Action Area associated with federal fluid mineral activity. BLM will track and report depletions against the 3,962 AF amount on a yearly basis. Given the variability and uncertainty in projecting well drilling and freshwater use amounts, this consultation will remain valid unless the identified freshwater use threshold is exceeded by greater than 10% in a given year or exceeds the threshold by any amount up to 10% over two consecutive years. In the event the annual depletion amount is exceeded under either scenario, BLM will revisit this consultation via conferencing with the USFWS. Exceeding the estimated depletion amount in a given river sub-basin in a given year will not require reinitiation of consultation, but BLM will conference with USFWS.

Colorado BLM will obtain data on reported freshwater used for all completion work on all federal wells from within the Action Area from the COGCC annually and will tally all reported freshwater use associated with drilling of all federal wells within the Action Area via the Condition of Approval that will be applied to all APDs starting January 1, 2017. These water use amounts will be summarized and the Dust Abatement amount added to all wells to calculate a total annual water depletion amount that will be submitted at the end of each calendar year to USFWS and tracked against the overall projected threshold freshwater use amount of 3,962 AF.

With respect to conservation measure bullet number 3 (see Section V), as a means of offsetting the impacts associated with the depletion of freshwater from the BLM's management of the

federal fluid minerals program within the Action Area, the BLM obtained a one-time monetary contribution from the industry representative group Independent Petroleum Association of Mountain States (now known as Western Energy Alliance) when the 2008 PBO was issued. The 2008 PBA/PBO analyzed water use over a 15-year timeframe; a payment of $71,978.34 was made to the National Fish and Wildlife Foundation on behalf of the Endangered Fish Recovery Program based on the 4,046 AF threshold identified in the 2008 consultation effort. Since the 2008 threshold was never exceeded, and the revised threshold in this re-consultation is below that amount, no new payment is required at his time. In December 2023 (the end of the 15-year timeframe addressed in the 2008 PBO), BLM will calculate a revised payment amount for 2024-2027 (or another appropriate future timeframe), based on water use from 2017-2023 and other available information.

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